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Phytochemical analysis and antibacterial activity of *Plectranthus amboinicus*

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Abstract

Plectranthus amboinicus is a perennial succulent herb characterized by thick, fleshy, and aromatic leaves covered with soft hairs. The leaves possess a strong oregano-like aroma due to the presence of essential oils. The plant typically grows up to 30–90 cm in height and produces small flowers arranged in terminal spikes. It thrives well in warm climates and can be easily propagated through stem cuttings. This study aims to evaluate with the phytochemical screening using different solvent extracts, namely chloroform and ethanolic extract, additionally find the antibacterial activity of *Plectranthus amboinicus.* Dried and powdered samples were subjected to solvent extraction through Soxhlet methods. Each extract was analyzed qualitatively for the presence of major phytochemical groups such as alkaloids, flavonoids, tannins, saponins, glycosides, phenols, and terpenoids using standard protocols. The results revealed that ethanolic extract contained the highest variety of phytochemicals, indicating their efficiency in extracting both polar and semi-polar compounds followed by chloroform. The test against pathogenic bacterial strains involved various concentrations of sample extract (100, 150, and 200 mg/mL) and they all showed good activity.

Keywords: *Plectranthus amboinicus,* phytochemicals, and antibacterial activity.

1. Introduction

Medicinal plants have been used by humans since ancient times for the treatment and prevention of various diseases. Plant-based medicines play an important role in traditional healthcare systems across the world. Many civilizations such as those practicing Ayurveda, Unani, Siddha, and traditional Chinese medicine have relied heavily on plant-derived preparations for maintaining health and curing illnesses. Plants produce a wide variety of secondary metabolites that possess significant pharmacological activities, including antimicrobial, antioxidant, anti-inflammatory, anticancer, and antidiabetic properties. Due to their natural origin and therapeutic potential, medicinal plants continue to be an important source of novel pharmaceutical compounds and modern drug development [1]. The increasing prevalence of infectious diseases caused by pathogenic microorganisms has become a major public health concern worldwide. Bacterial infections are responsible for a wide range of illnesses affecting humans, animals, and plants. Although antibiotics have played a crucial

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role in controlling bacterial diseases, the emergence of antibiotic-resistant bacterial strains has significantly reduced the effectiveness of many commonly used antibiotics. Antibiotic resistance is primarily caused by the overuse and misuse of antimicrobial drugs, leading to the development of resistant microorganisms that are difficult to treat. This situation has created an urgent need for the discovery of new antimicrobial agents from alternative sources [2].

Medicinal plants are considered promising sources of new antimicrobial compounds because they contain a diverse range of phytochemicals that exhibit biological activity against various pathogens. Plant extracts contain several secondary metabolites such as alkaloids, flavonoids, phenolic compounds, tannins, saponins, glycosides, and terpenoids. These phytochemicals are known to possess antimicrobial properties and can inhibit the growth of bacteria and other microorganisms. The antimicrobial activity of plant extracts may occur through different mechanisms, including disruption of microbial cell membranes, inhibition of enzyme activity, interference with protein synthesis, and inhibition of nucleic acid replication [3].

In recent years, the search for plant-based antimicrobial agents has gained considerable attention due to the increasing demand for natural medicines and safer therapeutic alternatives. Plant-derived antimicrobial compounds are often associated with fewer side effects compared to synthetic drugs. Additionally, herbal medicines are widely available, affordable, and culturally accepted in many parts of the world. Scientific investigation of medicinal plants helps validate their traditional uses and provides valuable information about their pharmacological properties [4]. Among the many medicinal plants used in traditional medicine, *Plectranthus amboinicus* (Lour.) Spreng., commonly known as Indian borage**,** Mexican mint**,** Cuban oregano**,** or country borage, has attracted considerable interest because of its diverse medicinal properties. *Plectranthus amboinicus* belongs to the family Lamiaceae, which includes several aromatic herbs known for their medicinal and culinary uses. The plant is widely distributed in tropical and subtropical regions of the world, including India, Southeast Asia, Africa, and the Caribbean. It is commonly cultivated in household gardens and used both as a culinary herb and a medicinal plant [5]. Because of its adaptability and ease of cultivation, the plant is widely grown in home gardens for medicinal and culinary purposes [6]. The study of antibacterial activity of plant extracts also has important applications in the pharmaceutical, food, and healthcare industries. Plant-derived antimicrobial compounds can be used as natural preservatives in food products, as therapeutic agents in medicine, and as antimicrobial agents in cosmetic and personal care products. Therefore, exploring the antimicrobial potential of medicinal plants such as *Plectranthus amboinicus* can contribute significantly to the development of safer and more effective natural products. Considering the medicinal importance and antimicrobial potential of *Plectranthus amboinicus*, the present study focuses on investigating the antibacterial activity of Indian borage extract against selected bacterial pathogens. The results of this study may provide scientific evidence supporting the traditional medici-

nal use of the plant and may contribute to the development of plant-based antimicrobial agents for the treatment of bacterial infections.

2. Materials and method

2.1 Qualitative Phytochemical analysis

The plant extract was tested for detecting various phytochemicals present in the Chloroform and Ethanolic extract of *Plectranthus amboinicus* using the standard procedure prescribed by (Harborne, 1998); (kokate et al., 2002)[7,8].

1) Test for carbohydrates

a) Molish's test

Plant extract was treated with few drops of Alpha naphthol and concentrated sulphuric acid added to it, the mixture in a slanting position. Observance of violet color ring indicates the presence of carbohydrates.

b) Benedict's test

0.5 ml of extract was treated with 0.5 ml of Benedict's reagent and kept for water bath for 2 minutes. Formation of precipitates indicates the presence of carbohydrates.

2) Test for tannins

a) Ferric chloride test

A small quantity of extract was mixed with water and heated in a water bath. The mixture was filtered and 5% of ferric chloride was added to the filtrate. A dark green color was formed. It indicates the presence of tannins.

b) Lead acetate test

3 ml of 10% lead acetate was added to the sample solution. Formation of bulky white precipitate indicates the presence of tannins.

3) Test for saponins

2 ml of distilled water was added with the sample solution and shakes well. Formation of foams indicates the presence of saponins.

4) Test for alkaloids

a) Mayer's test

The sample solution is treated with 2 drops of Mayer's reagent. Formation of white creamy precipitate indicates the presence of alkaloids.

b) Wagner's test

Few drops of Wagner's reagent were added with the sample. Formation of reddish-brown precipitate indicates the presence of alkaloids.

5) Test for Flavonoids

The sample solution is treated with 1 ml of 2N sodium hydroxide. Formation of yellow color indicates the presence of flavonoids.

6) Test for glycosides

The sample solution is treated with 3 ml of chloroform and 10% ammonia. Formation of pink color indicates the presence of glycosides.

7) Test for quinones

1 ml of concentrated sulphuric acid is added to the sample in slanting position. Formation of red color indicates the presence of quinones.

8) Test for Phenols

The sample solution is treated with few drops of 10% ferric chloride. Formation of blue or green color indicates the presence of phenols.

9) Test for terpenoids

The sample solution is added with 2 ml of chloroform and treated with concentrated Sulphuric acid. Formation of red brown color indicates the presence of terpenoids.

10) Test for steroids

Few drops of concentrated sulphuric acid is added to the sample solution in a slanting position. Occurrence of brown ring indicates the presence of steroids.

2.2Anti-bacterial activity of *Plectranthus amboinicus*

Plectranthus amboinicus extracts prepared from ethanol and chloroform were examined for their antibacterial capabilities. Four distinct bacterial strains were used to assess *Plectranthus amboinicus* antibacterial capabilities. To prepare this nutrition agar medium, 2.5 grams of nutrient agar were mixed with 100 milliliters of distilled water and autoclaved at 37 degrees Celsius for 24 hours. Apply the bacteria to the petri dish by means of the inoculation wire loop. The discs were made using grade 1 filter paper, which is the maximum level of purity. On infected agar plates, the discs were washed with 10, 20, and 30% w/v *Plectranthus amboinicus* extracts [9-11]. The next step was to incubate the plates at 37 degrees Celsius for a whole day. The antibacterial activity was determined by comparing the zone of inhibition to that of streptomycin, a commercial antibiotic, which served as a positive control. We tested every single extract and every single dose that could be administered [12].

3. Results & Discussion

Phytochemicals are the naturally occurring chemical substances found in plants. They provide the plant with color and organoleptic qualities. Although they are easily accessible as dietary supplements in many locations, phytochemicals' dormant health benefits can only be accessed by using the entire plant. In addition to providing "immunity against many diseases," phytochemicals are helpful in enhancing immunological responses. Certain phytochemicals, such as phenols, tannins, flavonoids, saponins, carbohydrates, alkaloids, and phytosterols, have been shown to exhibit physiological and therapeutic properties [13].

3.1 Phytochemical Analysis of *Plectranthus amboinicus*

In the *Plectranthus amboinicus* contain numbers of bioactive compounds in the both extractions process a standard qualitative phytochemical study can be done by using standard protocol. The comprehend distinct phytochemical such as sugars, tannin, phenols, Alkaloids, Flavonoids, glycosides, steroids, & Terpenoids [14-16].

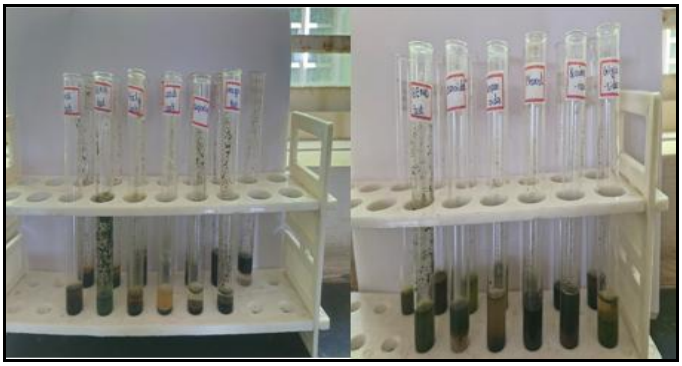

Figure 1. Chloroform extract of *Plectranthus amboinicus*

Figure 2. Ethanolic extract of *Plectranthus amboinicus*

Table 1: Phytochemical Constituents of *Plectranthus amboinicus*

S.no	Phytochemicals	Chloroform extract of *Plectranthus amboinicus*	Ethanolic extract *Plectranthus amboinicus*
1.	Carbohydrates	+	+
2.	Tannin	+	+
3.	Saponin	+	+
4.	Alkaloids	-	+
5.	Flavonoids	-	+
6.	Glycosidase	+	+
7.	Quinone	-	-
8.	Phenol	+	+
9.	Terpenoids	+	+
10.	Steroids	+	+

As shown in given table 1 Carbohydrates, tannin, phenols, saponins, alkaloids, flavonoids, glucosidase, quinone, terpenoids are present in the extract.

3.2 Anti-bacterial activity

The Anti-bacterial activity is defined as the method used to eradicate or protect from disease causing microorganisms. For this diversity of microbial agents was performed this anti-bacterial it's a common method using agar well diffusion Technique. The potential of *Plectranthus amboinicus* anti-bacterial agent done using agar well diffusion method [17]. Anti- bacterial activity towards the potential of gram positive & gram-negative bacteria for this were used four types of organisms *Klebsiella pneumonia, Escherichia coli, bacillus subtilis & staphylococcus aureus. Staphylococcus aureus, bacillus subtilis* are gram positive bacteria & *Klebsiella pneumonia, Escherichia coli* are gram negative bacteria for this experimental research work.

Table 2: Anti-bacterial activity of *Plectranthus amboinicus*

S.No.	Organisms	NC DMSO	PC	Zone of inhibition (mm)		
			Gentamycin	100 µg/ml	150 µg/ml	200 µg/ml
1.	*Klebsiella pneumonia*	Nil	6 (mm)	7	8	10
2.	*Escherichia coli*	Nil	6 (mm)	7	9	11
3.	*Bacillus subtilis*	Nil	5 (mm)	6	8	10
4.	*Staphylococcus aureus*	Nil	5(mm)	7	8	10

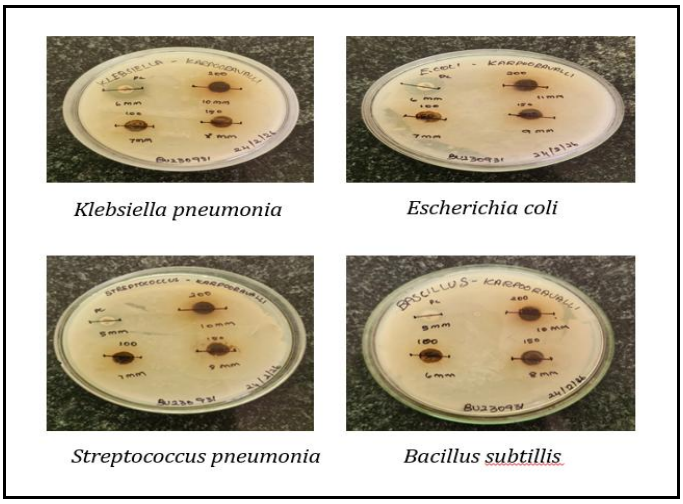

Figure 3. Anti-bacterial activity of *Plectranthus amboinicus*

The *Plectranthus amboinicus* had an Anti-bacterial effect agent these four as shown by an evident the zone of inhibition at 3 different concentration the *Plectranthus amboinicus* that has been dissolved in DMSO (6mg/3ml) in quantities of 100,150,200 µg DMSO was used as a negative control the zone of inhibition of plant source [18].

4. Conclusion

The present research work Pharmacological & Medicinal Activities of *Plectranthus amboinicus* including it have antibacterial. The presence of chemical elements in *Plectranthus amboinicus* is what causes potential to do have phar-

macological activities. The *Plectranthus* contain various number of bioactive compounds which was Confirmed by Phytochemical Analysis. *Plectranthus amboinicus* shows high antibacterial properties against pathogenic microorganism like *Klebsiella pneumonia, Escherichia coli, Bacillus subtilis, and Staphylococcus aureus.* This study has proven that they are several medicinal, pharmacological & health promoting potentials in the consuming & utilizing *Plectranthus amboinicus* for diverse uses.

Conflict of Interest: Nil

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References

[1] P. Bhatt, P.S. Negi, Food Nutr. Sci. 3 (2), (2012) 146–152.

[2] M.M. Cowan, Clin. Microbiol. Rev. 12 (4), (1999) 564–582.

[3] J.H. Doughari, M.S. Pukuma, N. De, Afr. J. Biotechnol. 6 (5), (2007) 565–569.

[4] S.K. Gupta, P.S. Negi, Food Technol. Biotechnol. 54 (1), (2016) 90–102.

[5] G.G.F. Nascimento, J. Locatelli, P.C. Freitas, G.L. Silva, Braz. J. Microbiol. 31 (4), (2000) 247–256.

[6] M. Rahman, S. Ahmed, M. Karim, Trop. J. Nat. Prod. Res. 7 (12), (2023) 2100–2107.

[7] S. Muthu, R. Krishnan, M. Raja, J. Drug Deliv. Ther. 9 (3), (2019) 239–243.

[8] R. Patel, M. Patel, S. Singh, Asian J. Pharm. Clin. Res. 13 (5), (2020) 123–127.

[9] C. Chinnahong, R. Charoensup, C. Phosri, Plants 11 (9), (2022) 1158.

[10] M.A. Taher, M. Muda, D. Susanti, J. Appl. Pharm. Sci. 12 (6), (2022) 112–118.

[11] M.A. Taher, M. Muda, D. Susanti, J. Appl. Pharm. Sci. 12 (6), (2022) 112–118.

[12] M.S. Filipe, I.C.F.R. Ferreira, L. Barros, Plants 10 (12), (2021) 2638.

[13] S. Kumar, V. Kumar, O. Prakash, Int. J. Pharm. Sci. Res. 15 (2), (2024) 620–628.

[14] M.S. Filipe, I.C.F.R. Ferreira, L. Barros, Plants 10 (12), (2021) 2638.

[15] G. Duraisamy, R. Ganesan, M. Karthikeyan, J. Ethnopharmacol. 268, (2021) 113563.

[16] M.O. Barbosa, M.F. Alves, L.R. Silva, I.C.F.R. Ferreira, Molecules 28 (15), (2023) 5653.

[17] N. Revathi, A. Sengottaiyan, K. Balamurugan, Spectrochim. Acta A Mol. Biomol. Spectrosc. 128, (2014) 171–177.

[18] S. Gulla, S. Natarajan, L. Ravi, Ecotoxicol. Environ. Saf. 259, (2024) 115089.